Universidade de Aveiro Escola Superior de Saúde
2015

Joana Batista de Castro Pinto

Condição física relacionada com a saúde e atividade física em adolescentes portugueses

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Dissertação apresentada à Universidade de Aveiro para cumprimento dos requisitos necessários à obtenção do grau de Mestre em Fisioterapia, realizada sob a orientação científica da Doutora Alda Marques, Professora Adjunta da Escola Superior de Saúde da Universidade de Aveiro.

O júri

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Palavras-chave Condição física; Cardiorrespiratória; Força muscular; Neuromuscular; Flexibilidade; Physical activity index; Adolescentes.

Resumo

Enquadramento: A fisioterapia promove, mantém ou restaura movimento e funcionalidade. Assim, um dos seus principais objetivos consiste em manter indivíduos ativos e com uma condição física adequada. Para isso são necessários valores normativos relativos às várias componentes da condição física relacionada com a saúde, para a adequada prescrição de exercício em populações saudáveis ou com patologia.

Objetivo: Contribuir para o desenvolvimento de valores normativos dos testes mais utilizados na fisioterapia para avaliar a condição física em adolescentes Portugueses, analisando as diferenças entre género. Explorou-se também a relação entre estes valores e o nível de atividade física (AF) dos adolescentes.

Métodos: Um estudo transversal foi realizado em colaboração com duas escolas da região de Aveiro. Dados sociodemográficos, antropométricos, clínicos, sinais vitais e dados de função pulmonar foram recolhidos para caracterizar a amostra. Os níveis de AF foram avaliados através do "Physical Activity Index". A condição física relacionada com a saúde (CFRS) foi avaliada através de: índice de massa corporal (IMC), teste de marcha com carga progressiva (TMCP), dinamometria manual (DM), teste modificado de sentar e alcançar (TMSA) e teste de levantar e ir (TLI).

Resultados: Cento e quarenta e um adolescentes (n=141) participaram neste estudo (71 rapazes) com uma média de idade de 14.33±1.34 anos. As médias e intervalos de confiança a 95% obtidos em cada teste foram: IMC 58.95 [54.12 – 63.77] percentil; TMCP 1251.19 [1199.25 – 1303.13] metros; FMQ 21.04 [19.67 – 22.41] quilogramas-força; TMSA 38.09 [34.58 – 41.60] centímetros; TLI 4.31 [4.05 – 4.58] segundos. Os adolescentes do sexo masculino obtiveram melhores resultados nos testes de CRFS que os do sexo feminino, à exceção do IMC. Os resultados do PAI mostram que os adolescentes têm uma AF moderada e que, quanto maior a sua pontuação neste questionário, melhores os resultados em três dos testes de CFRS (TMCP; TMSA; TLI).

Conclusão: Os valores obtidos neste estudo são uma contribuição para o desenvolvimento de valores normativos para estes testes. Confirma-se que níveis mais elevados de AF estão relacionados com melhores resultados de CFRS.

Keywords Physical fitness; Cardiorespiratory; Muscular strength; Neuromuscular; Flexibility; Physical activity index; Adolescents.

Abstract

Introduction: Physiotherapy develops, maintains or restores movement and function, thus maintaining people physically active and with adequate physical condition is one of its main objectives. Therefore, normative values are necessary for the various components of health-related physical fitness (HRPF), for the correct prescription of exercise in healthy or not healthy populations.

Objective: To contribute to the establishment of normative values of the measures most commonly used in physiotherapy to assess HRPF in Portuguese adolescents, examining gender-specific differences and the relationship between HRPF and physical activity (PA).

Methods: A cross-sectional study was conducted. Socio-demographic, anthropometric data and vital signs were collected in adolescents (12-17 years old). Their PA levels were assessed using the "Physical Activity Index" (PAI). HRPF was assessed through: body mass index (BMI), incremental shuttle walk test (ISWT), hand-held dynamometry (HHD), modified sit-and-reach test (MSRT) and timed up and go (TUG).

Results: One hundred and forty one adolescents participated (71 males). The mean and its 95% confidence intervals obtained for each test were: BMI 58.95 [54.12 – 63.77] percentile; ISWT 1251.19 [1199.25 – 1303.13] meters; HHD 21.04 [19.67 – 22.41] Kilograms; MSRT 38.09 [34.58 – 41.60] centimeters; TUG 4.31 [4.05 – 4.58] seconds. Male adolescents presented better performance in HRPF tests than females, except for BMI. Adolescents had moderate PA levels and, the higher these levels, the better were the results in three of the HRPF tests (ISWT; MSRT; TUG).

Conclusion: Findings are a contribution to the development of normative values for HRPF tests in Portuguese adolescents. Higher levels of PA were associated with better HRPF results.

Abbreviations and/or acronyms

BMI – body mass index

DBP – diastolic blood pressure

FEV_1 – forced expiratory volume in the first second

FVC – forced vital capacity

HHD – hand-held dynamometry

HR – heart rate

RR – respiratory rate

ISWT – incremental shuttle walk test

LAG – low activity group

MAG – moderate activity group

MSRT – modified sit and reach test

RR – respiratory rate

PA – physical activity

PAI – physical activity index

SBP – systolic blood pressure

SG – sedentary group

SpO2 – peripheral oxygen saturation

TUG – timed up and go test

VAG – vigorous activity group

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1. INTRODUCTION

Physiotherapy provides services on individual or collective (populations) basis to develop, maintain and restore maximum movement and functional ability throughout the course of life (1). The range of physiotherapy interventions includes manual therapy but also exercise tolerance, strength, stretching and balance training according to an individual's body composition (2–7).

In order to tailor these interventions to the individual's characteristics/condition, a number of measures are available, such as the body mass index (BMI) (8); incremental shuttle walk test (ISWT) (9); hand-held dynamometry (HHD) (10); modified sit and reach test (MSRT) (11) and timed up and go test (TUG) (12). These measures assess the components of health-related physical fitness (HRPF), the ones responsible for physical health (13), and are commonly used to prescribe exercise to different populations (4,14–17).

When normative values of the aforementioned measures are available, valuable information is provided to understand the extension of an individual's condition or impairment in function or disability, by comparing individual values to normative data (18). Considering the well-known differences between genders, normative values have been provided in a gender-specific perspective (19,20).

Although normative values for most of the HRPF measures used in physical therapy clinical practice are established for adult population (18,21–24), these are rare in adolescents (25), hindering an adequate exercise prescription and ultimately maximum movement and function recovery. These values are important to identify people with a condition or impairment in an HRPF component. Only thus it is possible to make a tailored intervention and assess the impact of that intervention on individual's functioning (18,19).

Health-related physical fitness components are measurable and tested in healthy children and adolescents through validated batteries such as Fitnessgram® (26), Eurofit® (27), or ALPHA (28). However, when assessing the HRPF in children and adolescents with neuromuscular (29–33), cardiorespiratory (24,34) or oncologic (5) conditions, the previously referred tests are more commonly used due to its simple and inexpensive application in clinical practice. Previous investigations have also established normative data for HRPF in European adolescents but a Portuguese sample was never included (35).

Therefore, there is a need to establish normative values of the HRPF tests that are most commonly applied in clinical practice to assess and monitor male and female adolescents with a specific condition, i.e., BMI for body composition; ISWT for cardiorespiratory fitness; HHD for muscular strength and MSRT for flexibility. Recently, it has been suggested that balance/agility or neuromuscular component should also be considered a HRPF component, as it has a strong relationship with health, namely in adolescents (35,36). Thus, TUG was used for the assessment of neuromuscular component.

Body composition is the relative amount of muscle, fat, bone, and other vital parts of the body (13). One of the most commonly used measures to assess body composition in clinical practice is the body mass index (BMI), as it is inexpensive and simple to perform (8). BMI is a reliable indicator of body fat, calculated from the relationship between height and weight (8). In children, it is specific for age and gender and BMI has already been set in percentiles for adolescent boys and girls (37,38). However, due to specific characteristics (socio-demographic, anthropometric), there is a need to account for the differences between populations (such as Portuguese adolescents) (39). This index has been used to analyse adolescents' body composition before and after interventions conducted in metabolic (6), cardiorespiratory (40–42), renal (43), neuromuscular (44) or oncologic diseases (45).

Cardiorespiratory fitness is defined as the ability of the cardiorespiratory and muscular systems to collect and consume oxygen during continuous physical activity (PA) (13). The ISWT, a field walking test, has been developed to assess this HRPF component in adults with chronic airway obstruction (9). This field test is frequently used in clinical practice due to its robust results and simple application (46). It has also been used to assess the cardiorespiratory fitness component of adults with cardiovascular disease (47,48), obesity (7) or cancer (4) and of children and adolescents with cystic fibrosis (41,49–52).

Muscular strength is the capacity of muscle to exert force (13). Isometric muscle strength assessed by hand-held dynamometry in youth has been used as an outcome measure in neuromuscular diseases (53), circulatory disorders (54) or chronic arthritis (55). Normative values of muscular strength in children between 4 and 16 years of age were established before using a "brake" test (56). However, previous research has suggested that the ''make'' test provides higher reliability results and is more easily understood by the individual under evaluation. In the "brake" test, the examiner progressively outgrows the muscle force being produced and stops resisting the movement when the extremity gives away. In the "make" test, the examiner holds the hand-held dynamometer in a static position while the individual

applies a maximal force against the dynamometer and examiner (57,58). In this study, the muscular strength was assessed with a "make" test. This test has been validated for youth (10). Quadriceps muscle strength has been associated with walking capacity and consequently with mobility, function and PA in children with a health condition (58–62). Therefore, its use is important in a HRPF assessment.

Flexibility is defined as the specific and intrinsic property of muscle and connective tissue that determines the range of motion available at a specific joint or group of joints (13,25). The MSRT assesses flexibility in adolescents and was created to overcome the limitation of the traditional sit and reach test concerning the length differences in arms, legs or trunk (11).

Agility, the neuromuscular component of HRFP, is the capacity to change the body position in space with speed and accuracy while maintaining control and balance (13,63). The TUG test was developed by Podsiadlo et al. (1991) for testing balance and agility in the elderly population but it was found to be also reliable in children (64). This test has been used to assess balance in children with normal development but also in children with neurologic (64,65) or cancer (17,66) conditions. Research on the normative values of this component in paediatric population is limited and studies are available only in children from Pakistan (67), USA (19) and Brazil (68).

Previous research has found that PA levels may influence the HRPF results by showing that adolescents who were more active also presented better scores in HRPF tests (69–71). Therefore, it is also important to determine PA levels of adolescents prior to establishing a physical fitness plan. Self-report questionnaires constitute a valuable and convenient measurement tool to assess PA in adolescents as they are easy to administer to large groups and enable the collection of quantitative and qualitative data (72). Physical Activity Index (PAI) is one of these instruments that has been validated and used to determine the Portuguese adolescents' PA levels (69,73).

Thus, the objective of this study was to contribute to establishing normative values of the most commonly used measures in physical therapy practice to assess HRPF in Portuguese adolescents, according to gender. A secondary aim of this study was to explore the relationship between the HRPF measures and PA levels.

2. METHODS

2.1. Study design and Ethics

A cross-sectional study was conducted as part of a larger study to assess the physical fitness and establish normative values of the most commonly used HRPF measures in physical therapy clinical practice with adolescents. Ethical approval was previously obtained from the Ethics Committee of the Research Unit of Health Sciences at the School of Nursing in Coimbra, Portugal (P246-12/2014) (Annex I).

Authorisations to conduct this study were requested and obtained from the School Boards of two school groups in Aveiro, Portugal (Annex II).

Prior to any data collection, information about the study was provided and written informed consents were collected from adolescents and their legal representatives (74).

2.2. Participants

Two school groups from the central region of Portugal (Aveiro) were invited and agreed to participate. An appointment was scheduled with the person responsible of each institution, during which the aims of the study were explained and informed consents and written information referring to the implementation of the study were provided (Appendix I). Participants were eligible if: i) aged 12 to 17 years; ii) had a signed informed consent form from their legal representative confirming the adolescent's will to participate (Appendix II). Exclusion criteria included: i) being an athlete (as it would affect the establishment of the normative values for non-athlete adolescents); ii) the existence of neurological impairment; iii) significant cardiorespiratory, metabolic and/or musculoskeletal disorders and iv) any significant impairment that could preclude them of performing the protocol physical tests, such as visual or hearing impairments.

2.3. Procedures

Socio-demographic (sex, age), clinical (medication, and clinical history) and anthropometric (weight and height) data were first collected to characterise the sample. Afterwards vital signs (heart rate, peripheral oxygen saturation, blood pressure) and lung function (forced vital capacity (FVC), forced expiratory volume in the first second (FEV_1) and FEV_1/FVC ratio) were assessed. The PA questionnaire was also applied as part of the initial assessment to characterise the sample.

The HRPF measures were then collected, starting with the body composition assessment, followed by the assessment of cardiorespiratory fitness, muscular strength, flexibility and neuromuscular components.

2.4. Measures

Physical Activity. PA was assessed with PAI (69). This test has five questions, in which the answers can be scored between 1 and 4 points, with the maximum continuous score of 20 and minimum of 5 points. This scale enables grouping people into four categories: sedentary group (SG) (score=5); low active group (LAG) (score=5-10); moderately active group (MAG) (score=10-15) and vigorously active group (VAG) (score=15-20). The reliability and internal consistency of PAI were assessed by Mota & Esculcas (2002) using a sample of Portuguese healthy children (mean age=15.9 years; range between 13 and 20), with excellent values of test-retest reliability (Intraclass correlation coefficient [ICC]=0.92 to 0.96) and good internal consistency (Cronbach's α=0.87).

Body Composition. Weight and height were measured with a JOFRE® mechanical weight and height scale to the nearest 0.1 kg and 0.5 cm. Measurements were conducted with participants in underwear and without shoes. Height was measured with heels together and after a deep inhalation. Body mass index was calculated as body weight in kilograms divided by the square of height in meters (13). An anthropometric calculator (AnthroPlus Software), available at the World Health Organization website (http://www.who.int/growthref/tools/en/) (75), was then used to determine the BMI percentile for each participant.

Cardiorespiratory Fitness. The ISWT was used to assess cardiorespiratory fitness (9). Excellent reliability (ICC=0.88, 95% Confidence Intervals [CI] 0.83 – 0.92) of this test has been reported for patients with chronic obstructive pulmonary disease (76). An adaptation of the protocol was used as described in Probst et al. (2012), in order to reach the maximal effort since the participants were healthy adolescents. Participants were required to walk between two cones (10-meter course; cones were inset 0.5 m from either end to avoid abrupt direction changes) during specific time frames controlled by audio signals played from a record. The initial walking speed was 0.5 m/s (1st level) and it increased 0.17 m/s each minute; a triple beep indicated the speed increment or change of level. The audio signals continued until participants were too breathless or could not perform the distance at two consecutive beep times, exceeding 12 levels of speed with the possibility of running, if necessary (24). The levels achieved and corresponding distance in meters were recorded.

The ISWT was performed twice due to the learning effect and the best performance was considered (76). A 30-minute rest was given to participants between repetitions. Before and after each ISWT, dyspnoea and fatigue were measured with the Modified Borg Scale (77,78), heart rate and peripheral oxygen saturation with a pulse oximeter (PULSOX-300i, Konica Minolta Sensing, Inc., Osaka, Japan) and arterial blood pressure with an automated sphygmomanometer (Elite, Medel, Parma, Italy). Heart rate and peripheral oxygen saturation were also monitored during the test, as recommended (46).

Muscular Strength. Quadriceps isometric muscle strength was assessed using a hand held dynamometer (HHD) (Hoggan MicroFET2 Muscle Tester, Model 7477, Pro Med Products, Atlanta, GA), with a "make" test (10). The validity of this test was fair to good (ICC 95% IC 0.52 – 0.74). Intra- and inter-rater reliability was also fair to good, for 95% ICC IC varied from 0.41 to 0.71. Participants performed the test in a sitting position, with the knee 90º flexed, the hip 90º flexed and trunk in upright position. The researcher placed the HHD in the anterior surface of the dominant leg, proximal to the ankle (5 cm above the lateral malleolus). The participant performed at least one practice trial to understand the movement and the adequate stabilisation provided by the researcher. Two trials were performed with a 10-second contraction followed by a 60-second resting period(10).

Flexibility. The MSRT is a common test applied to assess flexibility (13). This test has excellent test-retest reliability (ICC=0.94) (11). The MSRT was performed with the participants in a sitting position with head, back and hip (90º) against the wall and the plantar surface against a wooden box; one hand was placed over the other. In the initial position, participants were instructed to reach the measurement scale (only scapular abduction was allowed, but head and back had to remain in contact with the wall). The fingertips were placed on the ruler and that point was considered the relative zero point. In the ending position, participants reached the further point in the measuring scale. The final score was the distance between the zero point (initial position) and the point reached in the ending position. Two practice trials were allowed. Then, the best performance of two additional trials, in centimetres, was considered (11).

Neuromuscular Component. The TUG was performed due to its clinical relevance, as it is a simple and useful test in the assessment of the functional mobility of individuals before, during, and after treatment (68). Although investigations in the paediatric population are still scarce (68), one study reported an excellent test–retest reliability of the TUG in children aged 3-9 years (ICC=0.83; 95% CI=0.77 to 0.88) (64). Participants were instructed to start the test

in the sitting position with hips, knees and ankles close to a 90º flexion. Then, at the word 'go', participants walked three meters until a mark on the floor, turn and seat on the chair, as fast as possible but without running. Timing started when the participant left the seat, and stopped when the participants' back touched the back of the chair (67). Participants performed the test three times and the test with the shortest time, in seconds, was considered (64).

2.5. Statistical Analysis

Data were analysed using IBM SPSS Statistics version 22. Descriptive statistics were used to characterise the sample. Differences between male and female adolescents were analysed with independent t-tests. The one-way analysis of variance (ANOVA) was used to verify the need of dividing the sample in age groups: 12-13, 14-15 and 16-17 years old as this is a common procedure in the literature (10,67,68,79). There were no significant differences in HRPF tests between age groups ($p>0.05$), hence only one age group was considered (12-17 years old). The normality of data was assured using the Kolmogorov-Smirnov and Shapiro-Wilk tests (when the sample size was lower than 30 participants) (80). The normative values were reported in means and 95%CI.

Pearson correlations were used to evaluate the correlation between variables of the HRPF tests and the PAI continuous score. Correlations were considered significant at $p<0.05$. The results of HRPF tests were compared between participants according to their PA levels (i.e. SG; LAG; MAG; VAG), using one-way ANOVA. If the ANOVA was significant, pairwise comparisons using the Scheeffe test were performed to identify the groups with statistical differences (80).

3. RESULTS

Participants' characteristics are shown in Table 1. The sample included 141 participants (71 males) with a mean age of 14.33±1.34 years old (range from 12 to 17) and normal vital signs (heart rate: 80.4±13.2bpm, $p=0.273$; SpO2: 97.7±1.6%, $p=0.386$) and lung function values (FEV1 %pred.: 106.46±12.26; FVC %pred. 99.50±11.47). No significant differences were observed between male and female adolescents regarding these characteristics except for PAI in which male adolescents showed a significant higher score than female (males: 13.83±3.38; females: 12.29±3.43, $p=0.006$), indicating that male adolescents were more physically active than females. Participants' mean level of PA was moderate (13.06±3.38) (69).

Table 1 –Characterisation of the total sample (n=141), male (n=71) and female (n=70) adolescents aged 12-17 years.

	Total (n = 141)	Male (n = 71)	Female (n = 70)	p-value
Age (yrs)	14.33 (1.34)	14.13 (1.54)	14.53 (1.07)	0.074
Height (m)	1.63 (9.09)	1.64 (0.11)	1.62 (0.07)	0.097
Weight (Kg)	55.19 (11.65)	55.88 (12.69)	54.49 (10.54)	0.482
HR (bpm)	80.41 (13.19)	79.20 (12.13)	81.64 (14.18)	0.273
RR (cpm)	20.40 (3.50)	20.34 (3.22)	20.46 (3.78)	0.841
SBP (mmHg)	121.21 (15.62)	121.45 (16.10)	120.96 (14.85)	0.852
DBP (mmHg)	73.91 (9.92)	74.17 (9.71)	73.64 (10.18)	0.754
SpO2 %	97.73 (1.62)	97.61 (1.68)	97.85 (1.56)	0.386
FEV1/FVC	94.91 (8.60)	93.17 (8.95)	96.33 (8.11)	0.076
FEV1 %pred.	106.46 (12.26)	106.12 (12.77)	106.73 (11.95)	0.811
FVC %pred.	99.50 (11.47)	99.74 (11.90)	99.31 (11.23)	0.858
PAI	13.06 (3.38)	13.83 (3.16)	12.29 (3.43)	0.006*

Results are presented as mean (standard deviation).

HR: heart rate; RR: respiratory rate; SBP: systolic blood pressure; DBP: diastolic blood pressure; SpO2: peripheral oxygen saturation; FEV1: forced expiratory volume in the first second; FVC: forced vital capacity; PAI: physical activity index; yrs, years; bpm: beats per minute; cpm: cycles per minute.

Table 2 presents the HRPF data. Participants had a normal BMI for their age, being slightly above the 50th percentile (58.95±2.45%) (37,38). The BMI and SRT were not significantly different between male and female adolescents. Conversely, male adolescents presented significantly better performance values than female in TUG, ISWT and HHD ($p<0.001$), i.e., males were faster performing TUG (males: 3.75±0.43s; females: 4.88±0.87s $p<0.001$), walked a superior distance in the ISWT (males: 1409.00±265.63m; females: 1111.94±251.10 mp<0.001) and had more strength (males: 23.77±7.13kgf; females: 18.70±6.28kgf $p<0.001$) than females.

Table 2 - Normative values for health-related physical fitness tests for the total sample and for male and female adolescents aged 12-17 years

Test	Total (n = 141)	Male (n = 71)	Female (n = 70)	p-value
BMI (percentile)	58.95 [54.12 – 63.77]	62.64 [55.89 – 69.39]	55.20 [48.24 – 62.16]	0.13
ISWT (m)	1251.19 [1199.25 – 1303.13]	1409.00 [1340.38 – 1477.62]	1111.94 [1051.16 – 1172.72]	<0.001*
HHD (kgf)	21.04 [19.67 – 22.41]	23.77 [21.72 – 25.81]	18.70 [17.03 – 20.36]	<0.001*
MSRT (cm)	38.09 [34.58 – 41.60]	40.14 [35.59 – 44.69]	35.86 [30.22 – 41.49]	0.22
TUG (s)	4.31 [4.05 – 4.58]	3.75 [3.56 – 3.94]	4.88 [4.50 – 5.25]	<0.001*

Results are presented as mean [lower and upper bound of 95% Confidence Interval].

BMI-for-age: body mass index for age; ISWT: incremental shuttle walking test; HHD: hand held dynamometry; MSRT: modified sit and reach test; TUG: timed up and go test

There were significant correlations between the PAI score and the MSRT (r=0. 592, p<0.001), TUG (r=-0. 543, p<0.001) and ISWT (r=0. 432, p<0.001) (Table 3). As the PAI score increased, the score of MSRT and ISWT also increased. This means that the most active adolescents were those who were the most flexible and who walked a longer distance. Additionally, an increase in the PAI score was related to a decrease in the TUG score, which means that the most active adolescents were those who performed the TUG faster. However, when the relationship between fitness tests and different groups of PA levels obtained from PAI was assessed, significant differences were only observed in the ISWT. Specifically, the VAG walked 394.02±123.18 more meters than the SG (p=0.020) and 278.81±72.47 more meters than the LAG (p=0.003).

Table 3 - Pearson correlations between physical activity index scores and health-related physical fitness tests.

Test / Variable	BMI	ISWT	HHD	MSRT	TUG
PAI	0.084	0.432**	0.174	0.592**	-0.543**

****Correlation is significant at the 0.001 level.**

*** Correlation is significant at the 0.05 level.**

PAI: physical activity index; BMI: body mass index; MSRT: modified sit and reach test; TUG: timed up and go test; ISWT: incremental shuttle walking test; HHD: hand held dynamometry.

4. DISCUSSION

This study assessed the HRPF measures in a sample of Portuguese adolescents to contribute for establishing the normative values in this population. This will allow identifying impairments in male and female adolescents aged 12-17 years old, with higher certainty.

The main findings of this study were that a) adolescents were within a normal percentile of body composition b) the adolescent males showed higher performance in HRPF tests than females, except for BMI and c) there was a relationship between PA levels and the ISWT, SRT and TUG tests, i.e. adolescents with higher levels of PA had better cardiorespiratory, flexibility and neuromuscular performance.

Body composition was within a normal percentile range. This finding is important as it is known that BMI levels higher than the normal range are associated with a worse performance in other HRPF tests (16,81). Is therefore possible to infer that, in this study, the results obtained in the other tests were not influenced by an altered body composition. However, similarly to what has been previously reported, males presented a higher BMI than females (35,37,38,81,82).

Adolescents walked a mean distance of 1251.19±296.97m in cardiorespiratory fitness assessment. To the best of our knowledge, there is only one study that has looked at ISWT in Brazilian children/adolescents with normal development (n=14) and with cystic fibrosis (7-15 years old) (41). Children with normal development performed 544.28±131.13m, which was a lower distance than that assessed in the present study. However, the age range was different and there was no distinction between males and females in the Brazilian sample, which limits the comparison between studies.

On average, quadriceps muscle strength was 21.04±7.12kgf. Research on muscle strength in healthy adolescents is scarce, nevertheless, an American study (53) investigating muscle strength in 17 children with Down syndrome and 17 healthy children (7-15) found values of quadriceps strength from the healthy children (32.83±10.91kgf) higher than the values obtained in the present study. This difference may be due to methodological differences during measurements. In the American study, a second researcher was present to stabilise the participants during data collection whereas, in the present study, an environment as close as possible to clinical practice was created (rarely a second health professional is available to collaborate in patient's assessment). Researchers and clinicians should therefore consider these differences in the research protocol when using the normative values obtained in those studies. In this study, a significant difference between adolescent males and females strength was also found with male adolescents presenting higher values than female (males: 23.77±7.13kgf; females: 18.70±6.28kgf $p<0.001$). As muscle strength plays a key role in adolescent rehabilitation, is important to be aware of gender differences.

Flexibility of healthy adolescents reached 38.09±12.09cm. There were no significant differences between the MSRT values of adolescent males and females, which contrasts with previous studies on HRPF that showed a higher flexibility in girls (16,70). Nevertheless, the values obtained (adolescent males: 40.14±11.03cm; adolescent females: 35.86±13.03cm) were similar to those of a study conducted in South African adolescents of 14 years of age (adolescent males: 42.22±9.12cm; adolescent females: 48.51±7.34cm) (70). These differences show the need to establish normative values to specific populations from different countries and diverse ages, so it can be applied with greater confidence in studies using the same population and in clinical practice.

Normative data for the neuromuscular component, assessed with the TUG test, has been previously reported in adolescents of Pakistan (83), U.S.A. (19) and Brazil (68). Using part of the data presented in the Pakistani study (i.e., the data of adolescents from 12 to 13 years of age), it was possible to conclude that results were similar to this study (12 yrs - 4.85±0.578s and 13 yrs - 4.78±0.463s versus 4.31±0.89s in the present study). Approximate findings were found in the American study, between children from 10 to 14 years old (3.8 ± 0.64s). The female adolescents' data in both studies were higher than the male data, which means that male adolescents present a better balance performance early in their lives when compared to female adolescents. Finally, the Brazilian study, where a sample of adolescents was clustered in two age groups (10-13 and 14-18), showed slightly higher but also similar values comparing to the total sample data of this study (5.57±0.75s and 4.99±0.87s). Nevertheless,

the participants' age range in previous investigation was different from the age range used in this study.

The PAI results showed that adolescents were moderately active supporting the results from previous investigations (69,73). Similarly to what has been reported in the literature, female adolescents were less active than male adolescents (72,73,84). It has been shown that PA is strongly related to the results of HRPF tests (16,69,72,73,84), i.e. higher PA levels - better HRPF test results (36,39,71,85). In this study, conducted with a Portuguese sample of adolescents, significant correlations were also found between PAI and ISWT, SRT and TUG and participants with higher PA levels presented better results in the HRPF tests, corroborating the literature. Therefore, promoting PA in adolescence is important so that adolescents are able to have better HRPF (86).

The main strength of this study was its contribution for the definition of normative values for HRPF tests used in clinical practice in the Portuguese adolescent population. Normative values will allow understanding whether the performance of adolescents in a specific HRPF test is within normal values and, if not, allow exercise prescription with greater confidence and safety. PA was also assessed since the knowledge of an individual PA level provides opportunities for the development of a tailored HRPF. The few studies conducted in this area and the methodological differences between studies show the importance of further investigation.

Nevertheless, some limitations of this study need to be acknowledged. Data from a relative small sample restricted to the central region of Portugal were collected, which limits the generalisation of the findings. Data from adolescents should be obtained with a larger sample considering ethnic characteristics. Furthermore, longitudinal studies should be performed to assess natural changes in individual growth and development. Other tests of equally simple and inexpensive application could have been used, such as the 6-minute walk test (87). This test was described as having the same response to exercise capacity as the ISWT (46). Therefore, normative values of this test should be assessed and considered in further studies. Another limitation relates to the fact that, in this study, a self-reported PA instrument was used to assess adolescents' PA levels, and there is a possibility that adolescents overestimated their PA. In the future, PA levels should be assessed more objectively through devices with validity in adolescents, such as accelerometers (88–90).

5. CONCLUSION

This study contributed for the establishment of normative values for Health Related Physical Fitness, i.e., body composition, cardiorespiratory, muscular strength, flexibility and neuromuscular components, of Portuguese adolescents (male and female). It also confirmed that higher levels of PA are associated with better HRPF results, which emphasizes the need to encourage adolescents to adopt more active lifestyles in order to improve their HRPF performance.

In physical therapy clinical practice, knowing the normal values of adolescent HRPF's condition is fundamental to prescribe adequate exercise in healthy adolescents and adolescents with health conditions as well as to assess intervention effects. Few studies have yet been conducted in this area; therefore, further investigation is required among the Portuguese adolescent population.

REFERENCES

1. World Confederation for Physical Therapy. Policy Statement. Description of physical therapy. The World Confederation for Physical Therapy. 2011. p. 1–12.

2. Mikkelsson LO, Nupponen H, Kaprio J, Kautiainen H, Mikkelsson M, Kujala UM. Adolescent flexibility, endurance strength, and physical activity as predictors of adult tension neck, low back pain, and knee injury: a 25 year follow up study. Br J Sports Med. 2006;40(2):107–13.

3. Crompton J, Galea MP, Phillips B. Hand-held dynamometry for muscle strength measurement in children with cerebral palsy. Dev Med Child Neurol. 2007;49:106–11.

4. Andersen AH, Vinther A, Poulsen L, Mellemgaard A. Do patients with lung cancer benefit from physical exercise? Acta Oncol (Madr). 2011;50:307–13.

5. Marchese VG, Chiarello LA, Lange BJ. Effects of physical therapy intervention for children with acute lymphoblastic leukemia. Pediatr Blood Cancer. 2004;42:127–33.

6. Racette SB, Deusinger SS, Deusinger RH. Obesity: Overview of Prevalence, Etiology, and Treatment. Phys Ther. 2003;8(3):1365–9.

7. Quinn A, Doody C, Shea DO. The effect of a physical activity education programme on physical activity , fitness , quality of life and attitudes to exercise in obese females. J Sci Med Sport. 2008;11:469–72.

8. Mei Z, Grummer-Strawn LM, Pietrobelli A, Goulding A, Goran MI, Dietz WH. Validity of body mass index compared with other bady-composition screening indexes for the assessment of body fatness in children and adolescents. Am J Clin Nutr. 2002;75:978–85.

9. Singh SJ, Morgan MD, Scott S, Walters D, Hardman a E. Development of a shuttle walking test of disability in patients with chronic airways obstruction. Thorax [Internet]. 1992 Dec 1;47(12):1019–24. Available from: http://thorax.bmj.com/cgi/doi/10.1136/thx.47.12.1019

10. Hébert LJ, Maltaisp DB, Lepage C, Saulnier J, Crête M, Perron M. Isometric muscle strength in youth assessed by hand-held dynamometry: a feasibility, reliability, and validity study. Pediatr Phys Ther [Internet]. 2011 Jan [cited 2014 Oct 19];23(3):289–99. Available from: http://www.ncbi.nlm.nih.gov/pubmed/21829128

11. Hoeger WWK, Hopkins DR, Button S, Palmer TA. Comparing the Sit and Reach With the Modified Sit and Reach in Measuring Flexibility in Adolescents. Pediatr Exerc Sci. 1990;2:156–62.

12. Podsialo D, Richardson S. The Timed “Up & Go”: a test of basic functional mobility for frail elderly persons. J Am Geriatr Soc. 1991;39:142–8.

13. American College of Sports Medicine. ACSM's Guidelines for Exercise Testing and Prescription. 9th ed. Philadelphia: Lippincott Williams & Wilkins; 2013.

14. Sewell L, Singh SJ, Williams JEA, Collier R, Morgan MDL. How long should outpatient pulmonary rehabilitation be ? A randomised controlled trial of 4 weeks versus 7 weeks. Thorax. 2006;61:767–71.

15. Sahlberg ME, Svantesson U, Thomas EMLM, Strandvik B. Muscular Strength and Function in Patients With Cystic Fibrosis<xref rid="AFF1">*</xref>. CHEST J. 2005;127(5):1587.

16. Fogelholm M, Stigman S, Huisman T, Metsämuuronen J. Physical fitness in adolescents with normal weight and overweight. Scand J Med Sci Sport. 2008;18:162–70.

17. San Juan AF, Fleck SJ, Chamorro-Viña C, Maté-Muñoz JL, Moral S, Pérez M, et al. Effects of an intrahospital exercise program intervention for children with leukemia. Med Sci Sports Exerc. 2007;39(1):13–21.

18. Andrews AW, Thomas MW, Richard W. Normative Values for Isometric Muscle Force Measurements Obtained With Hand-held Dynamometers. Phys Ther. 1996;76(3):248–59.

19. Marchese VG, Oriel KN, Fry JA, Kovacs JL, Ryan L. Weaver, Reilly M M, et al. Development of Reference Values for the Functional Mobility Assessment. Pediatr Phys Ther. 2012;24:224–31.

20. Fallahi a a, Sangari M. Health- Related Physical Fitness and Normative Data in Healthy Women , Tehran , Iran. Iran J Publ Heal. 2010;39(4):87–101.

21. Brown DA, Miller WC. Normative data for strength and flexibility of women throughout life. Eur J Appl Physiol Occup Physiol. 1998;78(1):77–82.

22. Bohannon RW. Reference values for the timed up and go test: a descriptive meta-analysis. J Geriatr Phys Ther. 2006;29(2):64–8.

23. Adegoke BO a., Akpan G a., Mbada CE. Normative Values of Lower Back and Hamstring Flexibility for Nigerians Using the Modified Sit-and-Reach Test. J Musculoskelet Res. 2012;15(03):1250015.

24. Probst VS, Hernandes N a., Teixeira DC, Felcar JM, Mesquita RB, Gonalves CG, et al. Reference values for the incremental shuttle walking test. Respir Med. 2012;106:243–8.

25. Pate R, Oria M, Pillsbury L, Measures F. Fitness Measures and Health Outcomes in Youth Russell Pate , Maria Oria , and Laura Pillsbury , Editors ; Committee on Board ; Institute of Medicine. 2012.

26. Morrow JR, Martin SB, Jackson AW. Reliability and Validity of the FITNESSGRAM®. Res Q Exerc Sport [Internet]. 2010;81(3):S24–30. Available from: http://www.tandfonline.com/doi/abs/10.1080/02701367.2010.10599691

27. Kemper HCG, van Mechelen W. Physical Fitness Testing of Children: A European Perspective. Pediatr Exerc Sci. 1996;8:201–14.

28. Ruiz JR, Castro-Piñero J, España-Romero V, Artero EG, Ortega FB, Cuenca MM, et al. Field-based fitness assessment in young people: the ALPHA health-related fitness test battery for children and adolescents. Br J Sports Med. 2011;45:518–24.

29. Maltais DB, Pierrynowski MR, Galea VA, Bar-Or O. Physical activity level is associated with the O2 cost of walking in cerebral palsy. Med Sci Sports Exerc. 2005;37:347–53.

30. Williams EN, Physio D. Investigation of the timed " Up & Go " test in children. 2005;(1991):518–24.

31. Damiano DL, Dodd K, Taylor NF. Should we be testing and training muscle strength in cerebral palsy? Dev Med Child Neurol. 2002;44:68–72.

32. Verschuren O, Takken T. Aerobic capacity in children and adolescents with cerebral palsy. Res Dev Disabil. 2010;31:1352–7.

33. Jankowicz-Szymanska A, Mikolajczyk E, Wojtanowski W. The effect of physical training on static balance in young people with intellectual disability. Res Dev Disabil [Internet]. Elsevier Ltd; 2012;33(2):675–81. Available from: http://dx.doi.org/10.1016/j.ridd.2011.11.015

34. Klijn PHC, Oudshoom A. Effects of Anaerobic Training in Children With Cystic Fibrosis * A Randomized Controlled Study. CHEST J. 2004;125:1299–306.

35. Ortega FB, Artero EG, Ruiz JR, España-Romero V, Jiménez-Pavón D, Vicente-Rodriguez G, et al. Physical fitness levels among European adolescents: the HELENA study. Br J Sports Med [Internet]. 2011 Jan [cited 2014 Sep 27];45(1):20–9. Available from: http://www.ncbi.nlm.nih.gov/pubmed/19700434

36. Ortega FB, Ruiz JR, Castillo MJ, Sjöström M. Physical fitness in childhood and adolescence: a powerful marker of health. Int J Obes. 2008;32:1–11.

37. WHO. BMI-for-age BOYS. WHO. 2007.

38. WHO. BMI-for-age GIRLS. WHO. 2007.

39. Gutin B, Yin Z, Humphries MC, Barbeau P. Relations of moderate and vigorous physical activity to fitness and fatness in adolescents. Am J Clin Nutr. 2005;81(4):746–50.

40. Benedetti FJ, Mocelin HT, Bosa VL, Mello ED de, Fischer GB. Energy expenditure and estimated caloric intake in asthmatic adolescents with excess body weight. Nutrition. 2010;26(10):952–7.

41. Coelho CC, Aquino E da S, Almeida DC de, Oliveira GC, Pinto R de C, Rezende IMO, et al. Análise comparativa e reprodutibilidade do teste de caminhada com carga progressiva (modificado) em crianças normais e em portadoras de fibrose cística. J Bras Pneumol. 2007;33(2):168–74.

42. Despres J-P. Body Fat Distribution and Risk of Cardiovascular Disease: An Update. Circulation. 2012;126:1301–13.

43. Johansen KL, Chertow GM, Ng A V, Mulligan K, Carey S, Schoenfeld PY, et al. Physical activity levels in patients on hemodialysis and healthy sedentary controls. Kidney Int. 2000;57(6):2564–70.

44. Souza MA de, Baptista CR de JA de, Benedicto MMB, Pizzato TM, Mattiello-Sverzut AC. Normative data for hand grip strength in healthy children measured with a bulb dynamometer: a cross-sectional study. Physiother (United Kingdom) [Internet]. The Chartered Society of Physiotherapy; 2014;100(4):313–8. Available from: http://dx.doi.org/10.1016/j.physio.2013.11.004

45. Ness KK, Baker KS, Dengel DR, Youngren N, Sibley S, Mertens AC, et al. Body Composition, Muscle Strength Deficits and Mobility Limitations in Adult Survivors of Childhood Acute Lymphoblastic Leukemia. Pediatr Blood Cancer. 2007;49:975–81.

46. Holland AE, Spruit M a., Troosters T, Puhan MA, Pepin V, Saey D, et al. An official European Respiratory Society/American Thoracic Society technical standard: field walking tests in chronic respiratory disease. Eur Respir J. 2014 Oct 30;44(6):1428–46.

47. Gregg EW, Cheng YJ, Cadwell BL, Imperatore G, Williams DE, Flegal KM, et al. Secular trends in cardiovascular disease risk factors according to body mass index in US adults. JAMA. 2005;293(15):1868–74.

48. Pepera G, McAllister J, Sandercock G. Long-term reliability of the incremental shuttle walking test in clinically stable cardiovascular disease patients. Physiotherapy [Internet]. The Chartered Society of Physiotherapy; 2010;96(3):222–7. Available from: http://dx.doi.org/10.1016/j.physio.2009.11.010

49. Rogers D, Prasad SA, Doull I. Exercise testing in children with cystic fibrosis. J R Soc Med. 2003;96(Suppl 43):23–9.

50. Selvadurai HC, Cooper PJ, Meyers N, Blimkie CJ, Smith L, Mellis CM, et al. Validation of shuttle tests in children with cystic fibrosis. Pediatr Pulmonol. 2003;35(2):133–8.

51. Radtke T, Stevens D, Benden C, Williams CA. Clinical exercise testing in children and adolescents with cystic fibrosis. Pediatr Phys Ther. 2009;21(3):275–81.

52. Bradley J, Howard J, Wallace E, Elborn S. Validity of a modified shuttle test in adult cystic fibrosis. Thorax. 1999;54(5):437–9.

53. Mercer VS, Lewis CL. Hip Abductor and Knee Extensor Muscle Strength of Children with and without Down Syndrome. Pediatr Phys Ther. 2001;13:18–26.

54. Mulvany R, Zucker-Levin AR, Jeng M, Joyce C, Tuller J, Rose JM, et al. Effects of a 6-week, individualized, supervised exercise program for people with bleeding disorders and hemophilic arthritis. Phys Ther. 2010;90(4):509–26.

55. Klepper SE, Giannini MJ. Physical conditioning in children with arthritis: Assessment and guidelines for exercise prescription. Arthritis Care Res. 1994;7(4):226–36.

56. Beenakker EAC, Van der Hoeven JH, Fock JM. Reference values of maximum isometric muscle force obtained in 270 children aged 4 to 16 years by hand-held dynamometry . Reference values of maximum isometric muscle force. Neuromuscul Disord. 2001;11:441–6.

57. Stratford PW, Balsor BE. A Comparison of Make and Break Tests Using Hand-Held Dynamometer and the Kin-Com. J Orthop Sport Phys Ther. 1994;19(1):28–32.

58. Wuang YP, Chang JJ, Wang MH, Lin HC. Test-retest reliabilities of hand-held dynamometer for lower-limb muscle strength in intellectual disabilities. Res Dev Disabil [Internet]. Elsevier Ltd; 2013;34(8):2281–90. Available from: http://dx.doi.org/10.1016/j.ridd.2013.04.010

59. Wessel J, Kaup C, Fan J, Ehalt R, Ellsworth J, Speer C, et al. Isometric strength measurements in children with arthritis: reliability and relation to function. Arthritis care Res Off J Arthritis Heal Prof Assoc. 1999;12(4):238–46.

60. Eek MN, Beckung E. Walking ability is related to muscle strength in children with cerebral palsy. Gait Posture. 2008;28:366–71.

61. Meer K de, Gulmans VA, van Der Laag J. Peripheral muscle weakness and exercise capacity in children with cystic fibrosis. Am J Respir Crit Care Med. 1999;159(3):748–54.

62. Sandstedt E, Fasth A, Eek MN, Beckung E. Muscle strength, physical fitness and well-being in children and adolescents with juvenile idiopathic arthritis and the effect of an exercise programme: a randomized controlled trial. Pediatr Rheumatol Online J [Internet]. 2013;11(1):1–10. Available from: http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=3614532&tool=pmcentrez&rendertype=abstract

63. Ortega FB, Artero EG, Ruiz JR, Vicente-Rodriguez G, Bergman P, Hagströmer M, et al. Reliability of health-related physical fitness tests in European adolescents. The HELENA Study. Int J Obes (Lond) [Internet]. 2008 Nov [cited 2014 Sep 18];32 Suppl 5:S49–57. Available from: http://www.ncbi.nlm.nih.gov/pubmed/19011654

64. Williams EN, Carroll SG, Reddihough DS, Phillips BA, Galea MP. Investigation of the timed “up & go” test in children. Dev Med Child Neurol. 2005;47(8):518–24.

65. Gorter H, Holty L, Rameckers EE a, Elvers HJWH, Oostendorp R a B. Changes in endurance and walking ability through functional physical training in children with cerebral palsy. Pediatr Phys Ther. 2009;21(1):31–7.

66. Ginsberg JP, Shesh NR, Carlson CA, Meadows AT, Hinds PS, Spearing EM, et al. A Comparative Analysis of Functional Outcomes in Adolescents and Young Adults With Lower-Extremity Bone Sarcoma. Pediatr Blood Cancer. 2007;49:964–9.

67. Habib Z, Westcott S. Assessment of Anthropometric Factors on Balance. Pediatr Phys Ther. 1998;10:101–9.

68. Nicolini-Panisson RDA, Donadio MVF. Normative values for the Timed Up and Go test in children and adolescents and validation for individuals with Down syndrome. Dev Med Child Neurol. 2014;56:490–7.

69. Ledent M, Cloes M, Telama R, Almond L, Diniz J, Piéron M. Participation des jeunes europeens aux activites physiques et sportives. Sport. 1997;(159/160):61–71.

70. Toriola OM, Minyeki M a. Health-related fitness, body composition and physical activity status among adolescent learners: The PAHL study. African J Phys Heal Educ Recreat Danc. 2012;18(4):795–811.

71. Morrow JR, Tucker JS, Jackson AW, Martin SB, Greenleaf CA, Petrie TA. Meeting physical activity guidelines and health-related fitness in youth. Am J Prev Med [Internet]. Elsevier Inc.; 2013;44(5):439–44. Available from: http://dx.doi.org/10.1016/j.amepre.2013.01.008

72. Zaragoza Casterad J, Generelo E, Aznar S, Abarca-Sos A, Julián JA, Mota J. Validation of a short physical activity recall questionnaire completed by Spanish adolescents. Eur J Sport Sci. 2012;12(3):283–91.

73. Mota J, Esculcas C. Leisure Time Physical Activity Behaviour. Structured and Unstructured Choices According to Gender, Age and Level of Physical Activity. Int J Behav Med. 2002;9(2):111–21.

74. Oliveira G, Pereira AD. Consentimento informado. Coimbra; 2006.

75. World Health Organization. WHO AnthroPlus. Geneva: WHO; 2007.

76. Singh SJ, Puhan MA, Andrianopoulos V, Hernandes NA, Mitchell KE, Hill CJ, et al. An official systematic review of the European Respiratory Society/American Thoracic Society: measurement properties of field walking tests in chronic respiratory disease. Eur Respir J. 2014 Oct 30;44(6):1447–78.

77. Borg GA V. Psychophysical bases of perceived exertion. Medicine and science in sports and exercise. 1982. p. 377–81.

78. Wilson RC, Jones PW. A comparison of the visual analogue scale and modified Borg scale for the measurement of dyspnoea during exercise. Clin Sci (Lond). 1989 Mar;76(3):277–82.

79. Holm I, Fredriksen PM, Fosdahl M, Vøllestad N. A normative sample of isotonic and isokinetic muscle strength measurements in children 7 to 12 years of age. Acta Paediatr Int J Paediatr. 2008;97(5):602–7.

80. Field A. Discovering Statistics using SPSS. 3rd ed. London: SAGE Publications Ltd; 2009.

81. Chen W, Lin CC, Peng CT, Li CI, Wu HC, Chiang J, et al. Approaching healthy body mass index norms for children and adolescents from health-related physical fitness. Obes Rev. 2002;3(3):225–32.

82. Andersen LB, Sardinha LB, Froberg K, Riddoch CJ, Page AS, Anderssen S a. Fitness, fatness and clustering of cardiovascular risk factors in children from Denmark, Estonia and Portugal: the European Youth Heart Study. Int J Pediatr Obes. 2008;3 Suppl 1:58–66.

83. Habib Z, Westcott S, Valvano J. Assessment of Balance Abilities in Pakistani Children: A Cultural Perspective. Pediatr Phys Ther. 1999;11:73–82.

84. Seabra AFT e, Maia JAR, Mendonça DM, Thomis M, Caspersen CJ, Fulton JE. Age and sex differences in physical activity of Portuguese adolescents. Med Sci Sports Exerc. 2008;40(1):65–70.

85. Aires L, Silva P, Silva G, Santos MP, Ribeiro JC, Mota J. Intensity of physical activity, cardiorespiratory fitness, and body mass index in youth. J Phys Act Health. 2010;7(1):54–9.

86. Salmon J, Booth ML, Phongsavan P, Murphy N, Timperio A. Promoting physical activity participation among children and adolescents. Epidemiol Rev [Internet]. 2007 Jan [cited 2014 Nov 3];29:144–59. Available from: http://www.ncbi.nlm.nih.gov/pubmed/17556765

87. Li AM, Yin J, Yu CCW, Tsang T, So HK, Wong E, et al. The six-minute walk test in healthy children: reliability and validity. Eur Respir J. 2005;25(6):1057–60.

88. Riddoch CJ, Bo Andersen L, Wedderkopp N, Harro M, Klasson-Heggebø L, Sardinha LB, et al. Physical activity levels and patterns of 9- and 15-yr-old European children. Med Sci Sports Exerc [Internet]. 2004 Jan [cited 2014 Nov 10];36(1):86–92. Available from: http://www.ncbi.nlm.nih.gov/pubmed/14707773

89. Nilsson A, Ekelund U, Yngve A, Sjöstrom M. Assessing Physical Activity Among Children With Accelerometers Using Different Time Sampling Intervals and Placements. Pediatr Exerc Sci. 2002;14(3):87.

90. Baquet G, Stratton G, Van Praagh E, Berthoin S. Improving physical activity assessment in prepubertal children with high-frequency accelerometry monitoring: A methodological issue. Prev Med (Baltim). 2007;44(2):143–7.

Appendix I – Information sheet (Legal representative)

Folha de Informação ao Encarregado de Educação

As investigadoras Joana Batista de Castro Pinto e Tânia Maria Pereira de Pinho**,** a frequentar o Mestrado em Fisioterapia da Escola Superior de Saúde da Universidade de Aveiro, sob a orientação científica da Professora Doutora Alda Sofia Pires de Dias Marques, vêm por este meio solicitar-lhe a autorização para a participação do seu educando no estudo clínico intitulado: "Caracterização e estabelecimento de valores normativos de condição física em adolescentes".

Mas, antes de decidir, é importante que compreenda porque é que a investigação está a ser realizada e o que é que a mesma envolve. Por favor, leia a informação com atenção e discuta a participação do seu educando, com outros se assim o entender. Se houver algo que não esteja claro para si ou necessitar de informação adicional, por favor não hesite em contactar a aluna ou a sua orientadora (contactos no final deste documento).

Muito obrigado desde já por ler a informação.

Qual é o propósito do estudo?

Este estudo visa estabelecer valores de referência para a condição física em crianças com patologia respiratória e saudáveis (12-17 anos). Estes testes permitem uma avaliação objetiva e segura da condição física de adolescentes sendo por isso largamente utilizados pelos fisioterapeutas para prescrever exercício físico em adolescentes com várias patologias como por exemplo, com asma, fibrose cística, patologia oncológica ou condições neuromusculares. No entanto, ainda não se encontram estabelecidos valores de referência que permitam diferenciar com segurança a normalidade das condições patológicas. Para que seja possível determinar estes valores de referência, vimos então solicitar-lhe autorização para que o seu educando participe neste estudo que será realizado na instituição de educação por ele frequentada.

Porque foi o meu educando escolhido?

O seu educando foi escolhido porque:

- se encontra a frequentar uma escola do distrito de Aveiro que deu permissão institucional para a realização do estudo,
- não apresenta qualquer tipo de contraindicação à participação no mesmo.

Tenho de aceitar a participação do meu educando?

A decisão de autorizar a participação do seu educando ou não é completamente sua. Se decidir autorizar vai-lhe ser pedido que assine dois consentimentos informados, um para si e outro para as investigadoras. No entanto, é totalmente livre de desistir a qualquer momento, sem que para tal tenha de dar qualquer justificação. A decisão de desistir ou de não participar, não afetará a qualidade dos serviços de educação, ou quaisquer outros, prestados ao seu educando agora ou no futuro.

O que acontecerá se autorizar a participação do meu educando?

Se decidir participar vai-lhe ser pedido que preencha o documento anexo a esta folha de informação relativamente à saúde do seu educando e que o entregue, bem como o consentimento informado, ao docente que entrou em contacto consigo.

Após receber o consentimento informado devidamente assinado, as alunas dirigir-se-ão à instituição de educação do seu educando e procederão à recolha de algumas medidas muito simples como o peso e a altura, e testes para avaliar a sua condição física. Estes testes consistem em avaliar a composição corporal, a força muscular, a flexibilidade, condição neuromuscular e a função cardiorrespiratória. Ser-lhe-á também pedido que responda a um questionário para avaliar as atividades físicas que o seu educando realiza dentro e fora da instituição.

A aplicação do protocolo terá a duração de aproximadamente 40 minutos e será realizado em horários compatíveis com as atividades educacionais, de forma a não afetar o programa letivo de atividades.

Quais são os efeitos secundários dos procedimentos do estudo?

Não existem efeitos secundários de participar no estudo.

Quais são as possíveis desvantagens e riscos se resolver autorizar a participação do meu educando?

Não existem quaisquer desvantagens ou riscos de participar no estudo.

Quais são os possíveis benefícios se eu resolver autorizar a participação do meu educando?

Não existem benefícios diretos de participar no estudo. No entanto, todas as medidas recolhidas na avaliação ser-lhe-ão comunicadas para que fique informado acerca do estado de saúde e físico do seu educando. Para além disso, a informação obtida neste estudo poderá ajudar a desenvolver valores de referência para testes largamente utilizados na fisioterapia, permitindo uma melhor avaliação e monitorização de adolescentes.

A participação será confidencial?

Toda a informação recolhida no decurso do estudo será mantida estritamente confidencial. Os dados recolhidos serão salvaguardados com um código, para que ninguém os possa identificar. Apenas as alunas responsáveis pelo projeto e a sua orientadora terão acesso aos dados.

O que acontecerá aos resultados do estudo?

Os resultados do estudo serão analisados e incorporados em dissertações de Mestrado e alguns serão publicados em Jornais e/ou conferências de finalidade científica. No entanto, em nenhum momento o seu educando será identificado. Se pretender obter uma cópia de qualquer relatório ou publicação, por favor solicite-o enviando *e-mail* para as alunas responsáveis pelo projeto.

Contacto para mais informações sobre o estudo

Se pretender obter mais informações sobre o estudo, pode telefonar ou escrever para:

Joana Pinto, Tânia Pinho e Alda Marques

Escola Superior de Saúde da Universidade de Aveiro,

Universidade de Aveiro,

Campus de Santiago,

Edifício III, 3810-193, Aveiro

Telefone: 234 247 113 ou 234 372 462

e-mail: pinto.joana@ua.pt; taniamariapinho@ua.pt**;** amarques@ua.pt

Muito obrigado por ter lido esta informação.

Appendix II – Informed Consent

Consentimento Informado

Título do Projeto: Promoção da atividade física pediátrica através da monitorização e *feedback* de uma aplicação de *smartphone*

Orientadora: Prof. Doutora Alda Sofia Pires de Dias Marques

Alunas de Mestrado: Joana Batista de Castro Pinto e Tânia Maria Pereira de Pinho

Por favor leia e assinale com uma cruz (X) os quadrados seguintes.

1. Eu confirmo que percebi a informação que me foi dada e tive a oportunidade de questionar e de me esclarecer. ☐
2. Eu percebo que a participação do meu encarregando é voluntária e que ele é livre de desistir, em qualquer altura, sem dar nenhuma explicação, sem que isso afete qualquer serviço de educação ou saúde que lhe seja prestado. ☐
3. Eu compreendo que os dados recolhidos durante a investigação são confidenciais e que só os investigadores responsáveis pelo projeto têm acesso a eles. E dou portanto, autorização para que os mesmos tenham acesso a esta informação. ☐
4. Eu compreendo que os resultados do estudo serão publicados numa dissertação de mestrado e jornais e/ou conferências de finalidade científica sem que haja qualquer quebra de confidencialidade e anonimato. E dou portanto, autorização para a utilização dos dados para esses fins. ☐
5. Eu confirmo que o meu encarregando foi questionado acerca da sua vontade em participar no estudo e que nenhuma avaliação foi realizada contra a sua vontade, sendo assim respeitada a sua autonomia. ☐
6. Eu concordo então em participar no estudo. ☐

Assinatura do Participante	Encarregado de Educação	Data	Assinatura

Investigador	Data	Assinatura

Annex I – Ethics' approval

COMISSÃO DE ÉTICA

da **Unidade Investigação em Ciências da Saúde - Enfermagem** (UICISA: E)

da **Escola Superior de Enfermagem de Coimbra** (ESEnfC)

Parecer Nº 246-12/2014

Título do Projecto:
Promoção da actividade física pediátrica através da monitorização e feedback de uma aplicação de *smartphone*

Identificação do Proponente

Nome(s): Joana Batista de Castro Pinto; Tânia Maria Pereira de Pinho

Filiação Institucional: Escola Superior de Saúde da Universidade de Aveiro

Investigador Responsável/Orientador: Profª Doutora Alda Sofia Pires de Dias Marques

Relator: José Carlos Amado Martins

Parecer

As proponentes pretendem desenvolver estudo que tem como objectivos "avaliar a actividade física nos adolescentes, antes e após uma intervenção baseada na monitorização e feedback dado por uma aplicação móvel de contagem de passos; avaliar o impacto de uma intervenção de prescrição de exercício físico incluindo consciencialização e adoção de estilos de vida e comportamentos saudáveis, realizada através das redes sociais, na actividade física dos adolescentes; caracterizar a actividade física dos adolescentes, utilizando uma aplicação móvel de contagem de passos". Para atingir os objectivos propõem-se a realizar "estudo randomizado controlado" junto de adolescentes com idades entre os 12 e os 17 anos, nos agrupamentos de escolas de Aveiro e de Esgueira. A randomização será realizada entre escolas.

O estudo inclui um momento de avaliação inicial, a monitorização da actividade física em ambos os grupos num período ininterrupto de 8 semanas e uma avaliação final. O grupo experimental participará de rede social fechada onde acontecerá um programa educativo sobre comportamentos e estilos de vida saudáveis. Os critérios de inclusão e exclusão são definidos. O critério de inclusão, "que possuam *smartphone* e façam uso diário do mesmo" será válido apenas para a análise de dados propriamente dita, não se aplicando às crianças para os processos de avaliação, formação e programa de actividade física.

São definidas as variáveis a avaliar, que incluem dados antropométricos, de força muscular, dados relativos ao exercício físico e sinais vitais e vários indicadores físicos e funcionais a avaliar pelas investigadoras.

A informação é colhida de forma anónima e confidencial, codificando-se os questionários. A base de dados será de acesso restrito pela equipa de investigação. A transmissão semanal de dados entre as crianças e os investigadores acontecerá por "descarga" anónima (codificada) no site. É apresentado exemplar dos instrumentos de colheita de dados.

É apresentado documento para informação aos encarregados de educação e mencionado a necessidade de consenso entre adolescente e encarregado de educação relativamente à participação no estudo. É apresentado também documento para

COMISSÃO DE ÉTICA

da **Unidade Investigação em Ciências da Saúde - Enfermagem** (UICISA: E)

da **Escola Superior de Enfermagem de Coimbra** (ESEnfC)

obtenção do consentimento que prevê a assinatura de ambos (adolescente e seu encarregado de educação). Ambos os documentos cumprem os requisitos para uma investigação deste tipo.
É apresentada cópia de ofício enviado aos responsáveis dos agrupamentos de escolas, e a respectiva resposta autorizando.

Face ao exposto, e tal como nos é apresentado, esta Comissão de Ética é de parecer favorável à concretização do estudo.

O relator: _____

Data: 28/01/2015 Presidente da Comissão de Ética: _____

Annex II – Institutions' approval

Autorização Institucional

Eu, Carlos Alberto Ventura Magalhães responsável pela instituição Agrupamento de Escolas de Aveiro declaro que fui informado dos objetivos do estudo científico intitulado: "Promoção da atividade física pediátrica através da monitorização e feedback de uma aplicação de *smartphone*", e concordo em autorizar a execução do mesmo nesta instituição, desde que o mesmo tenha um parecer positivo por uma Comissão de Ética independente. Caso necessário, a qualquer momento como instituição CO-PARTICIPANTE desta investigação poderemos revogar esta autorização, se comprovadas atividades que causem algum prejuízo a esta instituição ou ainda, a qualquer dado que comprometa o sigilo da participação dos integrantes desta instituição. Declaro também, que não recebemos qualquer pagamento por esta autorização bem como os participantes também não receberão qualquer tipo de pagamento.

Representante da Instituição	Data	Assinatura
	25.11.2014	

Investigador	Data	Assinatura
Tânia Pinho	25.11.2014	Tânia Pinho

FW: Projeto de investigação

Agrupamento de Escolas de Esgueira <ag.esgueira@esjml.edu.pt>

qua 17-09-2014 11:44

Inbox

Para:Tânia Pinho <taniamariapinho@ua.pt>;

Importância:Alto

Informo que estão autorizadas.

Helena Libório
Diretora

Agrupamento de Escolas de Esgueira
Escola Básica e Secundária Dr. Jaime Magalhães de Lima
Rua Padre José Maria Taborda - Esgueira
3804-306 Aveiro, PORTUGAL
TEL +351 234 302 480
http://esjmlima.prof2000.pt
http://www.facebook.com/aeesgueira

De: Tânia Pinho [mailto:taniamariapinho@ua.pt]
Enviada: terça-feira, 16 de Setembro de 2014 23:18
Para: direcao@esjml.edu.pt
Assunto: Projeto de investigação

Bom dia Professora Helena Libório!
Somos duas alunas do mestrado em Fisioterapia da Escola Superior de Saúde da Universidade de Aveiro, Joana Pinto e Tânia Pinho. Para prosseguir com os nossos estudos e melhoria do nosso conhecimento, propomo-nos no ano de dissertação (em curso) a realizar investigação na área da atividade física nos adolescentes, que infelizmente ainda é pouco estudada.
Para isso precisamos do seu apoio de forma a podermos contactar e recolher dados nos adolescentes entre os 12 e os 18 anos do Agrupamento de Escolas de Esgueira.
Em anexo enviamos a apresentação do projeto e a devida autorização, caso concorde com a parceria.
Estamos disponíveis para qualquer esclarecimento, seja via mail (taniamariapinho@ua.pt), telemóvel (963293726) ou presencialmente.
A nossa orientadora, a Prof. Alda Marques também estará à sua disponibilidade para qualquer esclarecimento!

Grata pela atenção!
Com os melhores cumprimentos,

Tânia Pinho